Intraseasonal Variations in Tropical Energy Balance: Relevance to Climate Sensitivity?

Franklin R. Robertson[1], Holly S. Ramey[2] and Jason B. Roberts[1]

[1]NASA Marshall Space Flight Center, Earth Science Office Huntsville, AL

[2, 1]Jacobs Engineering Group

Intraseasonal variability of deep convection represents a fundamental mode of organization for tropical convection. While most studies of intraseasonal oscillations (ISOs) have focused on the spatial propagation and dynamics of convectively coupled circulations, here we examine the projection of ISOs on the tropically-averaged heat and moisture budget. One unresolved question concerns the degree to which observable variations in the "fast" processes (e.g. convection, radiative / turbulent fluxes) can inform our understanding of feedback mechanisms operable in the context of climate change. Our analysis use daily data from satellite observations, the Modern Era analysis for Research and Applications (MERRA), and other model integrations to address these questions: (i) How are tropospheric temperature variations related to that tropical deep convection and the associated ice cloud fractional amount (ICF), ice water path (IWP), and properties of warmer liquid clouds? (ii) What role does moisture transport play vis-à-vis ocean latent heat flux in enabling the evolution of deep convection to mediate PBL – free atmospheric temperature equilibration? (iii) What affect do convectively generated upper-tropospheric clouds have on the TOA radiation budget?

Our methodology is similar to that of Spencer et al., (2007 GRL) whereby a composite time series of various quantities over 60+ ISO events is built using tropical mean tropospheric temperature signal as a reference to which the variables are related at various lag times (from -30 to +30 days). The area of interest encompasses the global oceans between 20^{o}N/S. The increase of convective precipitation cannot be sustained by evaporation within the domain, implying strong moisture transports into the tropical ocean area. The decrease in net TOA radiation that develops after the peak in deep convective rainfall, is part of the response that constitutes a "discharge" / "recharge" mechanism that facilitates tropical heat balance maintenance on these time scales. However, water vapor and hydrologic scaling relationships for this mode of variability cast doubt on the utility of ISO variations as proxies for climate sensitivity response to external radiatively forced (e.g. greenhouse gas-induced) climate change.

---

[1] Employed by University of Alabama in Huntsville, Atmospheric Science Department while contributing to this research.